a plurality of data sets of the driving data; and

a resolution changing unit that changes a time resolution, wherein each one of the plurality of data sets of driving data having an original time resolution, and the resolution setting unit that sets the original time resolution of each of the data sets to a predetermined time resolution.

REMARKS

Applicant thanks the Examiner for indication that claims 2-7 and 9-14 are drawn to the allowable subject matter.

By this amendment corrections of drawings Figs. 1-4, 6-8, 15, 19-20 are respectfully requested. All corrections to the drawings have been done with the purpose to coordinate the content of the specification with the graphical materials. More specifically, the legends 'prior art' are added to figures 1-3; the printer driver software 201a , described in the page 9, line 19-20 now is indicated in figure 4 and reference 256 for profile data adjusting unit replaced with correct one 250. The references 204, 211 for nozzle data converting portion and for the nozzle profile data are added to figure 6 and 7 respectively. Mentioned in the specification references 207, 312a and 207a are shown in figure 8. Figure 15 are corrected to fully comply with the description on pages 30-32 of the specification. Additionally, figure 20 was corrected to change the reference of second pulse bits from 2000 into 2002 as described in the specification on page 37, lines 19-20.

This amendment corrects the minor typographical errors in the specification.

Claims 2-14 are currently pending in the application. By this amendment, claim 1 is canceled and claims 2-3, 8-9, 12-13 are amended. More specifically, objected by the Examiner claims 2, 3, 12, and 13 are rewritten in independent form to include all of the limitation of the canceled claim 1. Attached hereto is a separate sheet entitled "Clean Copy of Claims" showing a clean copy of the amended claims 2-3, 8-9, 12-13, and a separate sheet entitled "Clean Version of Changes to Specification" showing the clean copy of replacement paragraphs to the specification. Support for the amendments of claims 2-3, 8-9, 12-13 is provided in at least Figures 4- 6 and at pages 17-20 of the present specification. No new matter is added. Reconsideration of the rejected claims in view of the above amendments and the following remarks is respectfully

requested.

Claim 1 was rejected under 35 U.S.C. §102(e) as being obvious by Wen et al. (U.S. Patent 6,046,822). This rejection is respectfully traversed based on the following discussion.

The present invention resolves the problem of improving a quality of printed images by controlling not only an impact position of an ink droplet but also the **amount of ink ejection** for each nozzle in according with an ink ejection speed. Applicant apparatus works the following way: a printing image is converted into bitmap data by Raster Image Processor and supplied into the Nozzle Data Converting Portion 204, which in its turn converts the bitmap data into pulse replacing data and further into driving data based on nozzle profile data, prestored in the computer portion. Specifically, the novel feature of the present invention resides in the nozzle data converting portion, shown in figure 6, and includes a profile data update unit 101 and a measuring unit 102. According to the present invention, the profile data update unit 101 changes the pulse data for each nozzle based on both the graph F1 and the target ink ejection amount M and the measuring unit 102 includes a CCD camera and allows precisely measure the center position of an ink droplet impact. Therefore, the present invention performs the ink ejection control so that an impact position of an ink droplet and an ink ejection amount are adjusted at the same time for each nozzle in addition to adjustment of the ink ejection speed.

The patent to Wen et al. teaches an improving of printing image by improved accuracy of an ink droplet placement on a receiver medium. In the other words Wen's et al. apparatus overcomes a tendency of the nozzles to eject ink droplets in directions different from an ideal direction by a waveform generator associated with the nozzle which generates an electronic waveform to be supplied to the nozzle for adjusting the droplet placement characteristic. First, Wen et al. do not teach an adjustment of ink amount for each nozzle as Applicant does. Second, the way how an ink droplet adjustment is performed by Wen et al. differs from the Applicant's approach. More specifically, Wen et al. generates a waveform by a waveform generator just before a nozzle selection. In opposite, Applicant assigns waveforms to each nozzle which is updated every time when any conditions of printing is changed. This updating procedure is a novel distinguishable feature of the present invention. To emphasize this distinction, the claims

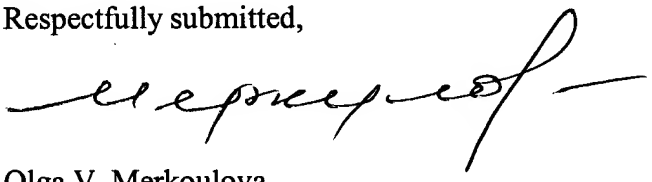
2, 3, 12, 13 have been rewritten in independent form to incorporate the limitations of canceled base claim 1. Specifically, claim 2 as amended recites, " an updating unit that updates the waveform data for each of the plurality of nozzles when a printing condition has been changed". As amended, it is submitted that claims 2, 3, 12, 13 clearly define over the patent to Wen et al.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wen et al. (U.S. Patent 6,046,822 in view of Mutoh et al. (U.S. Patent 4,673,951).

Responding to this rejection Claim 8 has been amended to be dependent of amended claim 3. Therefore the rejection is moot by the present amendment.

In view of the foregoing amendments and remarks, Applicant submits that all of the claims as amended are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicant hereby makes a written conditional petition for extension of time, if required. Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 50-2041(Whitham, Curtis and Christofferson. PC.).

Respectfully submitted,



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Clean Copy of Claims

The following is a clean copy of amended claims 2-3, 8-9, 12-13.

2. An ink jet recording device comprising:

a head formed with a plurality of nozzles;

a converting unit that converts recording data into driving data, the driving data including data sets defining driving pulses for corresponding ones of the plurality of nozzles;

a feed unit that feeds a recording medium in a first direction;

an ejection element provided to each one of the plurality of nozzles for ejecting an ink droplet from the corresponding nozzle onto the recording medium in response to the driving data while the feed unit is feeding the recording medium in the first direction;

a memory that stores nozzle profile data including waveform data and timing for each of the plurality of nozzles, the waveform data and the timing data indicating a waveform and a generating timing, respectively, of the driving pulse for each one of the plurality of nozzles, wherein the converting unit converts the recording data into the driving data based on the nozzle profile data, and each of the driving pulses is defined by a plurality of data sets of the driving data; and

an updating unit that updates the waveform data for each of the plurality of nozzles when a printing condition has been changed.

3. An ink jet recording device comprising:

a head formed with a plurality of nozzles;

a converting unit that converts recording data into driving data, the driving data including data sets defining driving pulses for corresponding ones of the plurality of nozzles;

a feed unit that feeds a recording medium in a first direction;

an ejection element provided to each one of the plurality of nozzles for ejecting an ink droplet from the corresponding nozzle onto the recording medium in response to the driving data

while the feed unit is feeding the recording medium in the first direction;

a memory that stores nozzle profile data including waveform data and timing data for each of the plurality of nozzles, the waveform data an the timing data indicating a waveform and a generating timing, respectively, of the driving pulse for each one of the plurality of nozzles, wherein the converting unit converts the recording data into the driving data based on the nozzle profile data, and each of the driving pulses is defined by a plurality of data sets of the driving data;

a designating unit that designates a target ink amount of the ink droplet and a target impact position on the recording medium on which the ink droplet impacts;

a measuring unit that measures a distance between the target impact position and an actual impact position on the recording medium where the ink droplet has impacted with respect to the first direction; and

an updating unit that updates the nozzle profile data based on the target impact position and the distance measured by the measuring unit.

8. The ink recording device according to claim 3, further comprising a deflection electric field generating unit and a charging electric field generating unit, the deflection electric field generating a deflection electric field in a space defined between the recording medium and the head, the deflection electric field having a field element in second direction substantially perpendicular to the first direction and a third direction in which the ink droplet is ejected, the charging electric field generating unit generating a charging electric field in the plurality of nozzles, the charging electric field having a field element in the third direction.

9. The ink jet recording device according to claim 8, wherein the designating unit designates the target impact position on the recording medium on which the ink droplet impacts with respect to both the first direction and the second direction;

the measuring unit includes:

a first measuring unit that measures a first distance between the target impact

position and an actual impact position on the recording medium where the ink droplet has impacted with respect to the first direction; and

a second measuring unit that measures a second distance between the target impact position and the actual impact position with respect to the second direction;

the updating unit updates the nozzle profile data based on the target impact position, the first distance, and the second distance.

12. An ink jet recording device comprising:

a head formed with a plurality of nozzles;

a converting unit that converts recording data into driving data, the driving data including data sets defining driving pulses for corresponding ones of the plurality of nozzles;

a feed unit that feeds a recording medium in a first direction;

an ejection element provided to each one of the plurality of nozzles for ejecting an ink droplet from the corresponding nozzle onto the recording medium in response to the driving data while the feed unit is feeding the recording medium in the first direction;

a memory that stores nozzle profile data including waveform data and timing dat for each of the plurality of nozzles, the waveform data and the timing data indicating a waveform and a generating timing, respectively, of the driving pulse for each one of the plurality of nozzles, wherein the converting unit converts the recording data into the driving data based on the nozzle profile data, and each of the driving pulses is defined by a plurality of data sets of the driving data; and

a leveling unit that levels generating timings of the driving pulses by changing the timing data of the nozzle profile data.

13. An ink jet recording device comprising:

a head formed with a plurality of nozzles;

a converting unit that converts recording data into driving data, the driving data including data sets defining driving pulses for corresponding ones of the plurality of nozzles;

a feed unit that feeds a recording medium in a first direction;

an ejection element provided to each one of the plurality of nozzles for ejecting an ink droplet from the corresponding nozzle onto the recording medium in response to the driving data while the feed unit is feeding th recording medium in the first direction;

a memory that stores nozzle profile dat including waveform data and timing data for each of the plurality on nozzles, the waveform data and the timing data indicating a waveform and a generating timing, respectively, of the driving pulse for each one of the plurality of nozzles, wherein the converting unit converts the recording data into the driving data based on the nozzle profile data, and each of the driving pulses is defined by a plurality of data sets of the driving data; and

a resolution changing unit that changes a time resolution, wherein each one of the plurality of data sets of driving data having an original time resolution, and the resolution setting unit that sets the original time resolution of each of the data sets to a predetermined time resolution.

Clean Version of Changes to Specification

Please replace the paragraph at page 4, lines 15-25 with the following paragraph.

Fig. 1, the dot 403 has a smaller diameter than the dot 401. Such a dot is formed when an ink amount of a corresponding ink droplet is insufficient. The dot 404 has an elongate shape in the Y direction. When an ink droplet being ejected has a higher ejection speed at its leading portion than the ejection speed at its tailing portion, then the ink droplet impacts onto the recording sheet 406 while having an elongate shape rather than a circular shape. This results in forming a dot having an unusual dot shape, such as the dot 404. The dot 405 is called satellite dot which has a larger dot and a smaller dot formed below and

Please replace the paragraph at page 5, lines 1-10 with the following paragraph.

separated from the lager dot. The satellite dot is formed when speed difference between a leading portion and a tailing portion of an ejected ink droplet is greater than that of the dot 404. That is, an ink droplet being ejected is divided into two or more droplets before the ink droplet impacts on the recording sheet 406 because of the speed difference. When recorded dots include these unusual dots, quality of images will be undesirably degraded. Such problems occur in any type of on-demand ink jet printer regardless of which type of ink or nozzles are used.

Please replace the paragraph at page 16, lines 6-12 with the following paragraph.

The driving data 212 generated in this manner may be temporarily stored in a memory (not shown) provided to the computer portion 201. Then, printing may be executed when a plurality of pages worth of driving data 212 is stored in the memory. However, in the present embodiment, the printing is executed every time when one page worth of driving data 212 is generated.

Please replace the paragraph at page 16, lines 13-24 with the following paragraph.

When nozzle data converting portion 204 has generated the driving data 212, then the

controller 205 controls the sheet feed unit 208 to feed a recording sheet. When a print start position of the recording sheet is detected, then the controller 205 transmits the driving data 212 from the computer portion 201 to the piezoelectric element driver 206. The piezoelectric element driver 206 generates a driving signal 213 with a relatively high voltage value based on the driving data 212. The driving signal 213 is then input to the signal input terminal 305 of the corresponding piezoelectric element 304 provided to the print head.

Please replace the paragraph at page 29, lines 12-25 with the following paragraph.

The deflection electrodes 1403 includes a first electrode 1403-1 and a second electrode 1403-2. The first electrode 1403-1 is applied with a deflection voltage Vc and a deflection voltage Vd. The deflection voltages Vc and Vd have a predetermined voltage value greater than 0v. The second electrode 1403-2 is applied with a deflection voltage -Vc which has an opposite polarity of the deflection voltage Vc applied to the first deflection electrode 1403-1, and also with a deflection voltage Vd which has the same polarity with the deflection voltage Vd applied to the first deflection electrode 1403-1. Accordingly, a deflection electric field Ec is generated between the deflection electrodes 1403-1 and 1403-2. The deflection electric fields Ec corresponds to a deflection

Please replace the paragraph at page 30, lines 1-5 with the following paragraph.

voltage difference 2Vc between the deflection electrodes 1403-1 and 1403-2. Also, because the nozzle plate 1401 is formed from a conductive material and is grounded, a deflection electric field element Eb corresponding to the deflection difference Vd is generated near the nozzle 207a.

Please replace the paragraph at page 30, lines 6-11 with the following paragraph.

When an ink droplet 1502 is ejected, the ink droplet 1502 is charged in the positive polarity by a charging amount q because of the electric field Eb. Thus charged ink droplet 1502 deflects rightward in Fig.15 because of the deflection electric field Ec. Accordingly, an impact position of the ink droplet 1502 is shifted rightward.

Please replace the paragraph at page 36, lines 17-25 with the following paragraph.

A driving data 212 is input to the circuit 2102. When the circuit 2102 detects a rising point of the received driving data 212, the counter 2103 starts counting the driving data clock 2104 and also outputs an ON-signal 2106 indicating that the counter 2103 is driving. The ON-signal 2106 is output to the logical multiplication 2105. Having counted eight clocks, the counter 2103 stops driving. The driving data 212 is also input to the logical multiplication 2105. When the logical multiplication 2105 receives the ON-

Please replace the paragraph at page 37, lines 1-16 with the following paragraph.

signal 2106, the logical multiplication 2105 outputs the driving data 212 to the shift register 2101. The driving data clock 2104 is also input to a clock of the shift register 2101 via the selector 2107, so eight bits of the driving data 212 is stored into the clock of the shift register 2101 one bit at a time. When an end of the ON-signal 2106 from the counter 2103 is detected, the counter 2108 starts. The counter 2108 counts a predetermined pulse data clock 2109, and stops counting when the counter 2108 has counted eight clocks. When an output signal from the counter 2108 is an ON-signal indicating that the counter 2108 is driving, then the selector 2107 switches to receive the pulse data clock 2109. Also, the shift register 2101 outputs the eight bits of the driving data 212 to the piezoelectric element driver 206 in synchronization with the pulse data clock 2109.